

I claim:

- 1 1. An apparatus for removing contrast from the coronary sinus during
2 angiographic and coronary intervention procedures to substantially prevent the
3 contrast from entering systemic circulation, comprising:
4 a catheter having a balloon tip to selectively occlude said vascular
5 circulation to thereby temporarily retain said contrast in a selected
6 portion of vascular circulation upstream of said coronary sinus;
7 a suction device to selectively remove said contrast from said vascular
8 circulation while temporarily retained in said selected portion of said
9 vascular circulation; and
10 a controller to stop said suction device when at least a predetermined
11 amount of said contrast has been removed from said vascular
12 circulation.

can be manual

- 1 2. A method for minimizing renal failure due to contrast injected in at least
2 one vessels of the heart during angiographic and coronary intervention
3 procedures, comprising:
4 disposing a catheter having a balloon tip through a femoral vein and
5 into a selected portion of said at least one vessel;
6 inflating said balloon tip to selectively form an occlusion in said at least
7 one vessel to thereby temporarily retain said contrast in said
8 selected portion upstream of said occlusion of said at least one
9 vessel; and

10 removing at least a portion of said contrast from said at least one vessel
 11 while said contrast is temporarily retained in said selected portion of
 12 said at least one vessel until a predetermined concentration of said
 13 contrast in said vascular system is realized.

1 3. An apparatus for occluding a coronary sinus vein and removing contrast from
 2 blood upstream of an occluded portion of said coronary sinus vein before
 3 permitting a remnant of said contrast to enter body circulatory systems via said
 4 blood, said apparatus comprising:

5 a catheter having:

6 a balloon tip on one end for insertion into and occlusion of
 7 said vein, said balloon tip comprising a bend; and
 8 a suction device for removing said contrast by suctioning
 9 through said catheter; and

10 a controller for starting and stopping said suction device at specific
 11 times.

1 4. The apparatus of claim 3 wherein said suction device comprises a syringe for
 2 suctioning said contrast through a lumen of said catheter distal to a balloon of
 3 said balloon tip.

1 5. The apparatus of claim 4 wherein said controller comprises:
 2 manual manipulation interface on a plunger of a syringe for beginning
 3 and ending suctioning, and

4 visual means for monitoring said vein for determining a presence of
 5 said contrast in said vein prior to beginning or ending said suctioning.

1 6. The apparatus of claim 3 wherein said catheter comprises a tip with an
 2 inflatable balloon thereon and said suction device comprises a pump for
 3 suctioning said contrast through a lumen of said catheter having an orifice distal
 4 to said balloon.

1 7. The apparatus of claim 6 wherein said controller comprises:
 2 a manual electrical switch for turning said pump on and off, and
 3 visual means for monitoring said vein for determining a presence of
 4 said contrast in said vein prior to turning said pump on and off.

1 8. The apparatus of claim 6, wherein said controller is an electronic controller
 2 and further comprising:
 3 a sensor at said tip for sensing properties of a fluid in said vein,
 4 said controller automatically turning said pump on and off, wherein said
 5 sensor sends a signal to said controller when said sensor is actuated
 6 by a predetermined property measurement.

1 9. The apparatus of claim 6, wherein:
 2 said pump is a first pump and said apparatus comprises a second
 3 pump; and

4 said controller has at least one timer coordinating an injection of said
5 contrast upstream of said vein with an inflation of said balloon, said
6 controller; wherein:

7 said at least one timer actuates said second pump and said
8 second pump inflates said balloon at a first predetermined
9 time interval relative to said insertion of said contrast, and
10 said at least one timer actuates said second pump and said
11 second pump deflates said balloon at a second
12 predetermined time interval relative to said insertion of said
13 contrast.

1 10. The apparatus of claim 9 wherein said first predetermined time interval is
2 from 15 minutes before to 3 seconds after injection of said contrast upstream of
3 said vein.

1 11. The apparatus of claim 10 wherein said first predetermined time interval is
2 approximately 1 second.

1 12. The apparatus of claim 9 wherein said at least one timer actuates said first
2 pump to start said suctioning by said first pump after a second predetermined
3 length of time between 1 second and 2 seconds after injection of said contrast
4 upstream of said vein.

1 13. The apparatus of claim 12 wherein said at least one timer stops said first
2 pump after a duration of suctioning in a range from 3 to 20 seconds.

1 14. The apparatus of claim 13 wherein said duration of suctioning is in a range
2 from 5 to 10 seconds.

1 15. The apparatus of claim 3 wherein said bend comprises a C-shape.

1 16. The apparatus of claim 3 wherein said bend comprises an S-shape.

1 17. A method of isolating a substance in a vessel and a volume of a heart and of
2 removing said substance in blood from said vessel and said volume of said heart
3 during angiographic and coronary intervention procedures to lower an amount of
4 said substance that is permitted to enter said heart and systemic circulation of
5 the body, said method comprising:

6 inserting a first catheter having a bend on a distal end through a natural

7 via of said body to said vessel, wherein said first catheter has a

8 means for occluding;

9 inserting a second catheter through another natural via of said body to

10 a location upstream of said vessel;

11 injecting said substance into said location upstream of said vessel;

12 forming an occlusion in said vessel by said means for occluding of said

13 first catheter;

14 suctioning said blood and said substance from said vessel upstream of
 15 said occlusion; and
 16 removing said occlusion after a majority of said substance has been
 17 suctioned out of said vessel.

1 18. The method of claim 17, wherein said first catheter is a balloon tipped
 2 catheter and said means for occluding comprises a balloon tip, said steps of
 3 occluding and suctioning further comprising:

4 occluding said vessel by inflating said balloon tip of said first catheter at
 5 a first predetermined time from 15 minutes before to 3 seconds after
 6 said step of injecting ;
 7 suctioning said substance and blood from said vessel after a second
 8 predetermined time from 1 to 2 seconds after said step of injecting;
 9 suctioning said substance and blood from said vessel for a third
 10 predetermined length of time in the range of 3 seconds to 20
 11 seconds in duration.

1 19. The method of claim 18, wherein:

2 said first predetermined length of time is approximately 1 second;
 3 said second predetermined length of time is 2 seconds; and
 4 said third predetermined length of time is in the range of 5 to 10
 5 seconds.

20. The method of claim 17, wherein said first catheter is a balloon tipped catheter and said means for occluding comprises a balloon tip, and wherein said first catheter further has a sensor distal to a balloon of said balloon tip and a sensor wire running through said catheter to a controller, said method further comprising:

sensing a quantity concentration, or physical characteristic upstream of

said means for occluding by said sensor;

automatically sending a signal by said sensor to said controller when a predetermined quantity, concentration, or physical characteristic is detected; and

actuating by said controller at least one device connected with said controller for coordinating at least one other step in said method when said signal is received.

21. The method of claim 20, wherein:

said quantity and concentration comprise measures of oxygen or a specific chemical in said substance;

said physical characteristic comprises temperature or electrical properties; and

said at least one device comprises at least one of an alarm, a switch, and a timer.

1 22. The method of claim 21, wherein said first catheter further comprises a first
2 lumen connected to a first pump and a second lumen connected to a second
3 pump, said first lumen having an orifice distal to said balloon and said second
4 lumen being sealingly connected to said balloon, wherein:

5 said step of sensing further comprises sensing the quantity or
6 concentration of said substance in said vessel by said sensor;
7 said step of actuating by said controller comprising said controller
8 automatically inflating said balloon tip by said second pump and said
9 controller automatically suctioning said substance and said blood by
10 said first pump.

1 23. The method of claim 17, wherein said first catheter is a balloon tipped
2 catheter and said means for occluding comprises a balloon tip, and wherein said
3 first catheter further comprises a first lumen connected to a first pump and a
4 second lumen connected to a second pump, said first lumen having an orifice
5 distal to said balloon and said second lumen being sealingly connected to said
6 balloon, said first catheter being connected to a controller wherein:

7 said controller actuating at least one of a switch and a timer in said
8 controller for coordinating at least one additional step in said method
9 when a signal is received in said controller;

10 said signal is generated by manually actuating a switch button on said
11 controller when a presence of said substance is seen in said vessel
12 on a fluoroscopy screen.

24. The method of claim 23 wherein said controller comprises a plurality of devices comprising a switch for said first pump, a switch for said second pump, at least one said timer, said step of actuating comprising:

- said controller inflating said balloon by said first pump;
- said controller suctioning said substance and blood from said vessel by said first pump after a second predetermined length of time measured by said at least one said timer; and
- said controller turning off said first pump after a third predetermined length of time measured by said at least one said timer.

25. The method of claim 17, wherein said first catheter is a balloon tipped catheter and said means for occluding comprises a balloon tip, and wherein said first catheter further comprises a first lumen connected to a first pump and a second lumen connected to a second pump, said first lumen having an orifice distal to said balloon and said second lumen being sealingly connected to said balloon, said first catheter being connected to a controller wherein said controller comprises a first switch for said first pump and a second switch for said second pump, said method further comprising:

- manually actuating said second pump by said second switch and thereby inflating said balloon tip at a first predetermined length of time after insertion of said substance in said vessel;
- manually actuating said first pump by said first switch after a second predetermined length of time after insertion of said substance in said

14 vessel, and thereby suctioning said substance and blood from said
 15 vessel;
 16 turning off said first pump by said first switch after a third predetermined
 17 duration of suctioning, thereby stopping said suctioning; and
 18 deflating said balloon tip by actuating said second pump in a reverse
 19 direction by said second switch.

1 26. The method of claim 25, wherein said controller further comprises an alarm
 2 or a signal to notify said user that said first pump or said second pump should be
 3 actuated, said method further comprising:

4 actuating at least one of said pumps in response to said alarm or said
 5 signal.

1 27. The method of claim 17, further comprising the steps of:

2 filtering said blood and said substance to remove said substance from
 3 said blood; and
 4 reintroducing said blood into said body after it has been filtered,
 5 wherein a majority of said substance is successfully removed from
 6 said blood and prevented from entering a circulatory system of said
 7 body.

1 28. The method of claim 17, said step of suctioning further comprising removing
 2 from 67 to 99 percent of said substance from said vessel.

1 29. The method of claim 28, said step of suctioning further comprising removing
2 at least 90 percent of said substance.

1 30. The method of claim 17, wherein each of the steps of occluding by inflating,
2 suctioning, and deflating are accomplished by manually manipulating syringes.

1 31. The method of claim 17, wherein said via for said first catheter is a femoral
2 vein from a groin area to a heart of said body.

1 32. The method of claim 17, wherein said via for said first catheter is a jugular
2 vein from a neck to a heart of said body.

1 33. The method of claim 31, wherein said first catheter is a balloon tipped
2 catheter and said means for occluding comprises a balloon tip, and wherein said
3 bend is located in said balloon tip, said step of inserting said first catheter further
4 comprising:

5 selectively manipulating said first catheter to guide said balloon tip in a
6 sinuous bath by said bend to engage the balloon tip into said vessel
7 to be occluded.

1 34. The method of claim 33, wherein said bend is C-shaped.

1 35. The method of claim 33, wherein said bend is S-shaped.

1 36. A method of injecting a substance into and removing a substance from a
2 blood vessel of a human body as a primary or a secondary procedure, wherein
3 said substance stays in said vessel temporarily and is removed during said
4 procedure to avoid harmful effects by said substance on said human body, said
5 method comprising the steps of:

6 inserting a first balloon tip catheter percutaneously into said vessel;
7 inserting a second catheter percutaneously into a volume in fluid
8 communication with said vessel;
9 occluding said vessel by a means for occluding on an end of said first
10 catheter;
11 injecting said substance in said volume for natural flow toward said
12 vessel;
13 suctioning said substance in said volume and said vessel by a lumen in
14 said first catheter through an orifice in said catheter distal to said
15 means for occluding; and
16 coordinating the steps of the method by a controller connected to said
17 catheters.

1 37. The method of claim 36, wherein said step of injecting comprises injecting a
2 contrast, said method further comprising:
3 imaging said volume and said vessel by angiography while said
4 contrast is present in said volume and said vessel.

1 38. The method of claim 37, further comprising:
 2 selectively repeating said steps of injecting and imaging for imaging
 3 from a variety angles and locations as a primary procedure for
 4 gathering information about an interior of at least one of said vessel
 5 and said volume.

1 39. The method of claim 37, further comprising:
 2 selectively repeating said steps of injecting and imaging for imaging
 3 from a variety angles and locations as a secondary and
 4 complimentary procedure for gathering information about an interior
 5 of at least one of said vessel and said volume during a primary
 6 coronary intervention procedure on at least one of said volume and
 7 said vessel.

1 40. The method of claim 39, wherein said primary procedure is one of
 2 mechanical or chemical manipulation, and wherein said steps of injecting and
 3 imaging permit assessment of the primary procedure during said primary
 4 procedure.

1 41. The method of claim 39, wherein said vessel is a coronary sinus.

1 42. The method of claim 36, wherein said method further comprises injecting a
 2 contrast through said orifice of said first catheter.

1 43. The method of claim 36, wherein said step of injecting comprises injecting a
2 medication for therapeutic purposes on an interior of at least one of said vessel
3 and said volume.

1 44. A system for removing a substance that has been injected into the
2 vasculature of a human or veterinary patient, said system comprising:

3 a catheter having an expandable region that, when in an expanded
4 state, will occlude a selected region of the vasculature to retain the
5 substance in that region of the vasculature;
6 a suction device to remove at least a substantial portion of the injected
7 substance from the region of the vasculature within which the
8 substance has been retained; and
9 control apparatus to stop said suction device when at least a
10 predetermined amount of the injected substance had been suctioned
11 from the region of the vasculature within which the substance has
12 been retained.

1 45. A method for minimizing renal damage resulting from introduction of a
2 substance that causes renal damage into the vasculature of a mammalian
3 patient, the method comprising the steps of:

4 disposing a catheter having a balloon tip in a selected portion of said
5 vascular system;

6 inflating said balloon tip to selectively occlude said vascular system to
 7 thereby temporarily retain said contrast in said selected portion of
 8 said vascular system; and
 9 removing at least a portion said contrast from said vascular system
 10 while said contrast is temporarily retained in said selected portion of
 11 said vascular system until a predetermined concentration of said
 12 contrast in said vascular system is realized.

1 46. An apparatus for removing a quantity of an injected substance from an
 2 anatomical vessel within the body of a mammalian patient, said apparatus
 3 comprising:
 4 a catheter having:
 5 an occluder for occluding the vessel;
 6 a suction device for removing the injected substance from the
 7 vessel upstream of the occlusion created by the occluder;
 8 and,
 9 a controller for starting and stopping said suction device at
 10 specific times.

11 47. The apparatus of claim 46 wherein the catheter further comprises a lumen
 12 that extends through at least a portion of the catheter and has an aperture
 13 formed in the catheter upstream of the occluder such that the injected substance
 14 can be suctioned through the aperture and through the lumen.

15 48. The apparatus of claim 46 wherein said controller comprises:
 16 manual manipulation of a syringe for beginning and ending suctioning,
 17 and
 18 visual means for monitoring said vessel for determining a presence of
 19 said contrast in said vessel prior to beginning or ending said
 20 suctioning.

1 49. The apparatus of claim 46 wherein the occluder comprises a generally C
 2 shaped balloon.

1 50. The apparatus of claim 46 wherein the occluder comprises a generally S
 2 shaped balloon.

1 51. A method of isolating and removing at least a portion of a quantity of
 2 radiographic contrast medium that has been injected into the vasculature of a
 3 human or veterinary patient, said method comprising:

- 4 A) inserting a first catheter having an occluder into a vessel to be
- 5 occluded;
- 6 B) inserting a second catheter to a location upstream of the occluder;
- 7 C) injecting contrast into the patient's vasculature upstream of the
- 8 occluder;
- 9 D) causing the occluder to occlude the vessel such that at least a
- 10 portion of the injected contrast medium is retained upstream of the
- 11 occluder; ;

12 E) suctioning and removing from the vasculature at least a portion of
 13 the contrast medium that is retained upstream of the occluder; and
 14 F) causing the occluder to cease occlusion of said vessel.

15 52. The method of claim 51, wherein Step A comprises inserting a catheter
 16 having an occluder that comprises a balloon and wherein Steps D and E further
 17 comprise :

18 occluding the vessel by inflating said balloon at a first predetermined
 19 time from 15 minutes before to 3 seconds after the injection in Step
 20 C ;
 21 suctioning a fluid and said contrast from said vessel after a second
 22 predetermined time from 1 to 2 seconds after said step of injecting;
 23 suctioning said fluid and said contrast from said vessel for a third
 24 predetermined length of time in the range of 3 seconds to 20
 25 seconds in duration.

1 53. The method of claim 51, wherein said first catheter further comprises a
 2 sensor located distal to the occluder and wherein method further comprises the
 3 steps of:
 4 G) providing a controller which communicates with the sensor;
 5 H) using the sensor to sense the presence of a predetermined quantity
 6 or concentration of a substance or physical characteristic;

7 l) sending a signal from the sensor to the controller when the sensor
8 senses the predetermined quantity or concentration of said
9 substance or physical characteristic.

1 54. The method of claim 51, wherein said first catheter further comprises a first
2 conduit connected to a first pump and a second conduit connected to a second
3 pump, said first conduit having a lumen at an end of said tip distal to said balloon
4 and said second conduit being sealingly connected to said balloon, said first
5 catheter being connected to a controller wherein:

6 said controller actuating at least one device in said controller for
7 coordinating other steps in said method when a signal is received in
8 said controller;

9 said at least one device comprises one of an alarm, a switch, and a
10 timer; and

11 said signal is generated by manually actuating the controller when the
12 presence of a sufficient amount of contrast is viewed radiographically
13 upstream of the occluder.